U.S. ENVIRONMENTAL PROTECTION AGENCY
POLLUTION/SITUATION REPORT
Rico Argentine Mine - Removal Polrep

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region VIII

Subject: **POLREP #5**
Progress Pollution Report
Rico Argentine Mine
08BU
Rico, CO
Latitude: 37.6927729 Longitude: -108.0303502

To:
From: Steven Way, OSC
Date: 2/3/2016
Reporting Period: February 2014 to December 2015

1. Introduction

1.1 Background

Site Number:	08BU	**Contract Number:**	
D.O. Number:		**Action Memo Date:**	1/11/2011
Response Authority:	CERCLA	**Response Type:**	Time-Critical
Response Lead:	PRP	**Incident Category:**	Removal Action
NPL Status:	Non NPL	**Operable Unit:**	OU 1
Mobilization Date:		**Start Date:**	5/31/2011
Demob Date:		**Completion Date:**	
CERCLIS ID:		**RCRIS ID:**	
ERNS No.:		**State Notification:**	
FPN#:		**Reimbursable Account #:**	

1.1.1 Incident Category

Other – former mining/milling Site with a draining mine tunnel and associated underground workings.

1.1.2 Site Description

1.1.2.1 Location

The Rico Argentine Mine Site (Site) is located north of the town of Rico in Dolores County, Colorado, The St. Louis Tunnel (SLT) and the settling ponds area of the Site are located on the east bank of the Dolores River, but the mine workings extend into Telescope Mountain. Mine workings extend to the southeast surface near Silver Creek, which is east of the town of Rico. The ponds area is bound to the west by the Dolores River and U.S. Forest Service land on the east. A portion of many of the ponds as well as lands needed for various other aspects of the cleanup previously sat within U.S. Forest Service land boundaries, however land transfers under the Small Tracks Act have been completed such that these lands are now privately held. The remaining land covers several privately held mining claims with different owners. In some cases, the ownership of specific parcels is uncertain.

Additional information is provided in POLREPs #1, #2, #3 and #4.

1.1.2.2 Description of Threat

See POLREPs #1, #2, #3 and #4.

1.1.3 Preliminary Removal Assessment/Removal Site Inspection Results

See POLREPs #1, #2, #3 and #4.

2. Current Activities

2.1 Operations Section

2.1.1 Narrative

The actions implemented during the reporting period included general site maintenance, ongoing water quality and flow monitoring; managing the settling ponds and associated historic lime precipitation solids; design and construction of a Site solids repository; evaluation and design of hydraulic control alternatives for the St. Louis Tunnel; water treatment demonstration scale system (EWD), design, construction, and testing; and the design of and beginning construction on an Enhanced Constructed Wetland Treatment System (ECWTS).

2.1.2 Response Actions to Date

The initial work at this Site was performed under a Unilateral Administrative Order that was issued in 2011 and is described in detail in the previous POLREPs. During the time between POLREP 5 (2/3/2016) and this POLREP, an Administrative Order on Consent was issued, superseding the UAO in all respects.

General Site Work and Ongoing Monitoring

- ARCO is working with the U.S. Department of Agriculture Forest Service (USFS) to secure part of the land needed for the permanent solids repository and water treatment cells under the Small Tracts Act. EPA and USFS have coordinated on this topic. A portion of land acquisition is complete, and the application has been submitted for the remaining portion.

- Pond berms, spillways, outlet pipes, and freeboard are inspected monthly and deficiencies, primarily due to beaver activity, are corrected as needed.

- A weather station was installed in November 2014 to measure evaporation, precipitation, temperature, wind speed/direction, humidity, barometric pressure, and snow depth. A telemetry system transmits the weather station data and other Site data so the information and Site photos are viewable via Internet.

- Continuous (hourly) flow measurements are made at the St Louis Tunnel discharge downstream of the historic portal (station DR-3) and at the pond system outfall (DR-6) to the Dolores River using automated instrumentation. The DR-3 flow data is transmitted via the telemetry system for remote viewing.

- Water samples are collected seasonally (high flow, moderate/low flow, and low flow) from the St. Louis Tunnel discharge, two points within the pond system (discharge from Ponds 8 and 15), the outfall from the pond system to the Dolores River, and five locations in the Dolores River upstream, adjacent to, and downstream of the St. Louis settling pond system.

- Groundwater samples are collected and water levels are measured seasonally in monitoring wells (including some paired shallow/deep wells) located throughout the Site. Water levels are measured monthly in select wells.

- Continuous (hourly) pressure measurements are made at the St Louis Tunnel via monitoring wells AT-2 and BAH-01. During 2015 the readings were linked to Site telemetry to allow regular review and interpretation of the data.

Solids and Water Management

- Precipitation solids from historic lime addition water treatment were removed from the ponds and placed in the Interim Drying Facility (IDF) drying cells, located in the former Pond 16/17 area, to increase pond storage capacity, reduce the potential for releases to the Dolores River, and facilitate construction of water treatment units. During 2015 the solids from Ponds 14 and 18 were consolidated with other pond solids in IDF and are awaiting placement in the solids repository. Approximately 35,900 cubic yards (cy) of treatment solids and calcines combined are staged onsite. Treatment solids are drying and awaiting placement in the solids repository. Calcines may also be placed in the repository or potentially used as structural fill onsite.

- Calcines, a solid waste from roasting pyrite ore to produce sulfuric acid, are present at many Site locations including the former Pond 16/17 area, beneath Pond 13, between Pond 19 and the Voluntary Clean-up Plan (VCUP) soils repository, and elsewhere. In-place calcines were tested to determine if drainage from the lime precipitation solids or groundwater flowing through the calcines causes leaching of hazardous substances and potential migration off-site. Results to date indicate that the calcines are not contributing significantly to off-site releases associated with ground water; localized elevated levels of heavy metals are observed. Calcines were excavated during installation of the demonstration scale wetland in 2013 and stockpiled on Site. Additional calcines were excavated from the Pond 18 and Pond 14 areas during 2015 Expanded Wetland Demonstration system installation. Excavated calcines were tested to determine if they are suitable for use as fill in limited circumstances, such as fill for construction of lined wetland cell berms. If a suitable use can be found for these materials, the repository lifetime will be extended and the need for importing off-site fill material will be reduced.

- A lined solids repository (Phase 1) was designed and constructed during 2014 and 2015. The Phase 1 cell is designed for approximately 30,000 cy of waste. The repository design allows for expansion into the Pond 16/17 area, if needed, for a full build-out storage capacity of 365,000 cy. A Land Use Application and an Engineering Design and Operations Plan were submitted to EPA, the State of Colorado, and Dolores County. A Certificate of Designation was approved by Dolores County in March 2015 pursuant to state solid waste regulations. (While a CD/permit is not required as part of the CERCLA action, long-term regulatory control is anticipated to fall under the state solid waste program.)

- Repository construction began during June 2014 and was completed in 2015. Solids will be placed in the repository during 2016 for disposal. Soil excavated from the repository footprint was screened to provide road base and soil for other Site uses.

- The Site access road was realigned to the west of the repository footprint. Power and communications lines in the vicinity of the solids repository were buried along the new access road.

- Pond berms were evaluated during 2011-2013. The flood dike, forming the west bank of the settling ponds adjacent to the Dolores River, was upgraded in June 2012 based on 100-year flood modeling (HEC-RAS). Upgrades included: dike embankment filter material was added near seeps, larger and

more riprap was added near the upper ponds (18 and 15), and the elevation of the dike along Pond 9 was increased to provide more freeboard.

- In 2013 a buried pipe that posed stability concerns was identified in Pond 18. Pond 15 discharge structures were upgraded during 2015 along with Pond 14 headgates and piping. Pond 18 and Pond 14 berms were reconfigured and upgraded in 2015 during Enhanced Wetland Demonstration system installation.

Hydraulic Controls at St. Louis Tunnel Collapsed Adit Area and Mine Water Source Control

- The collapsed portion of the exposed St. Louis Tunnel extends approximately 250 feet from the concrete portal to the buried section of tunnel overlain by loosely consolidated (sand to boulder size) colluvium. The collapse ("debris plug") extends into the unexposed portion of the tunnel. The "terrain trap," as this area is referred to, presents a difficult and unsafe condition in which to attempt opening the tunnel or to construct controls to capture the mine water flowing from the tunnel through a debris plug. Two borings (AT-2 and BAH-01) were drilled through bedrock into the tunnel. The water levels and associated pressure on the blockage are monitored through the bore holes and are available real-time via telemetry.

- Recent inconsistencies between BAH-01 and AT-2 water levels during 2015 indicate that the debris plug may be more extensive than previously thought. Also, flows and water levels in the tunnel are being compared to assess potential changes in the permeability of the blockage. Siphon/drawdown/recovery step tests were performed on AT-2, and approximately 2.2 million gallons were siphoned from the mine pool as of December 1, 2015. Water levels will be monitored and additional hydraulic controls installed as needed to maintain the mine pool below a level of concern.

- Hydraulic control alternatives and potential failure modes were analyzed by ARCO. A model was developed in 2013 to assist in determining the anticipated flow from the St. Louis Tunnel before and after hydraulic controls are installed. A system to pump water from well AT-2, located approximately 260 feet behind the former portal structure and 50 feet behind the open collapsed adit, was installed during 2014 (Hydraulic Controls Phase 1). The system includes a pipe to transport pumped water to the DR-3 flume channel. During 2016 a pipe will be installed to carry water through the collapsed adit (Hydraulic Controls Phase 2).

- Underground mine workings investigations were performed in select portions of the extended mine workings during 2011, 2012, and 2015 to assess in-mine water chemistry, flow pathways, and the structural conditions of workings. DRMS developed recommendations for rehabilitation needed to ensure access and continued transport of water to the St. Louis Tunnel. EPA, Colorado DRMS, and ARCO supported these efforts.

    - The 517 Shaft and Blaine Adit portals were reconstructed in 2012 to provide structurally safe conditions to enter the adits. The portals and the initial sections of the adits were replaced with steel supports and steel lagging.
    - In the Blaine Adit, the existing coffer dam, approximately 350 feet inside was replaced in 2013 to ensure that acid mine water continues to flow down the workings and ultimately into the 517 Shaft and does not discharge from the adit to Silver Creek. The previous dam showed evidence of corrosion when the mine pool was drained for work in the adit in 2012.
    - A flume was installed in the Blaine Adit to measure the flow of water from the workings entering into the 517 Shaft via the Humboldt Drift. A pressure transducer was installed to measure flow through the flume and readings began in October 2012.
    - Blockages from rock falls in the Blaine Tunnel that were impeding flow to the Morris Cook Incline were removed to allow flow to continue towards the 517 Shaft. A portion of one of the blockages in the Humbolt Drift remains due to the ground / rubble that created an unsafe condition to continue without substantially more work. Water is flowing as needed towards the Morris Cook Incline.
    - A pool in the Argentine Mine Adit was sampled in 2011 and 2015. Extremely high metals concentrations point to this as a potentially significant source of contaminants discharging from the St. Louis Tunnel. In addition, flow measurements were conducted with DRMS and the conditions were evaluated in 2015 to determine the feasibility of conducting a tracing test within the mine. Metals loading from the Argentine Mine to the St. Louis Tunnel may be assessed during 2016 in coordination with ARCO. However, underground mine contractor support is required to conduct this work including DRMS contracting efforts.

- An Evaluation of Source Water Controls Report was prepared by ARCO in December 2013, and a revised report addressing EPA comments was submitted to EPA in October 2014. Mine water source controls beyond those described above appear to be an unlikely option at this time based on the conditions of the underground workings.

Water Treatment (St. Louis Tunnel mine drainage)

- A semi-passive bio-chemical water treatment system was selected for testing at the Site. A series of systems have been installed including pilot scale, demonstration scale and large scale (~ 500 gpm) for testing at the Site. The treatment systems include settling basins, bioreactors, aeration channels, and manganese removal cells. Details of the different systems are described below. The demonstration systems are being evaluated to confirm the performance and design features. To date, the metals removal efficiencies have been highly effective. Pending the results of the large scale system, Enhanced Demonstration Wetland (EDW), performance over the winter and during the run-off/ freshet, a decision will be made on the final design and build-out of the system. Currently, active lime treatment is the default treatment technology if the results of the bio-reactor testing do not demonstrate adequate reliability to meet potential discharge criteria.

- A significant advantage of the semi-passive, bio-reactor system is the operational stability over winter months without active onsite management. Avalanche risk onsite and access difficulty present significant challenges to operating active treatment systems in remote mountain locations. In addition, the reduced waste volume is a significant advantage to the bio-reactor cell, which is expected to operate without replacing the treatment matrix for 5 to 15 years.

- Pilot scale (1 to 10 gpm) was installed in 2013 and operated for over a year. The results from the pilot scale unit were reported in a previous Polrep and other reporting.

- The demonstration scale (10 to 50 gpm) passive water treatment systems were tested at the Site from 2014 through 2015. The demonstration scale system includes both a horizontal flow treatment train and a vertical flow biochemical reactor cell with pre-treatment train, each designed for 50 gpm. The two systems were installed to allow a comparison of performance and design considerations, especially comparing the horizontal and vertical flow bio-reactors. Water discharged from the vertical and horizontal flow systems has dissolved cadmium concentrations below the detection limit and zinc removal efficiencies consistently greater than 98 percent. Manganese removal efficiencies of up to 98 percent were observed in the horizontal flow system that includes the rock drain. The demonstration scale treatment components are as follows:

The horizontal flow system includes:

- Settling basin to remove solids and iron, with aluminum chlorohydrate added to assist in particulate coagulation
- Surface flow wetland containing soil and plants for additional iron removal
- Horizontal subsurface flow wetland containing rock, wood chips, manure, sulfur prills, fish fertilizer, and sulfate-reducing bacteria to reduce metals in water to solid metal sulfides
- Aeration channel to oxygenate the wetland discharge
- Rock drain containing rock and organisms to remove manganese

The vertical flow system includes :

- Settling basin (same as horizontal flow) to remove solids and iron, with aluminum chlorohydrate added to assist in particulate coagulation.
- Vertical flow biotreatment cell containing wood chips, wood shavings, manure, hay, and sulfate reducing bacteria to reduce metals in water to solid metal sulfides
- Aeration cascade to oxygenate the wetland discharge

  The demonstration wetland system was completed in August 2014 and was commissioned at 30 gpm during early September 2014; sampling began on September 16, 2014. System testing began after monitoring showed that the organisms responsible for anaerobic metal reduction and manganese precipitation were stable. Flow, water levels, temperature, pH, oxidation reduction potential, conductivity, hydrogen sulfide concentrations, and vegetation characteristics are monitored. The telemetry system provides remote access to key data. Samples are collected regularly at the inlet and outlet to each treatment unit.

  The demonstration systems will continue to operate as long as practical to help identify long-term operations and maintenance and disposal requirements.

- An Enhanced Wetland Demonstration (EWD) system was designed and constructed in 2015 to treat up to 550 gpm of mine discharge based on the results of the demonstration wetland testing. The EWD was installed in the Pond 18 and 14 areas and commissioned in 2015. The EWD includes a settling pond, manganese removal cell, vertical flow bioreactor, and aeration channel. Sensor equipment measures flow, water levels, temperature, pH, oxidation reduction potential, conductivity, hydrogen sulfide concentrations, which are monitored via telemetry system that provides remote access.. Water samples are collected regularly at the inlet and outlet to each treatment unit.

- A pilot scale in-situ (517 Shaft injection) water treatment test was conducted during 2012 and 2013. Potassium carbonate and sodium hydroxide were injected into the 517 Shaft to treat water. The test resulted in improved discharge water quality at the St. Louis Tunnel. While treatment in the shaft is feasible, the long-term operation poses technical challenges that have not been addressed. These studies did provide additional information as to the source of metals loads with the respective cross-cuts connecting to the St. Louis Tunnel.

- Bench scale ion exchange water treatment tests were conducted on Blaine Tunnel and St. Louis Tunnel waters during 2012, and ion exchange resins, effective for removing contaminants from each water source, were identified.

2.1.3 Enforcement Activities, Identity of Potentially Responsible Parties (PRPs)

- A Unilateral Administrative Order (UAO) was issued to the Atlantic Richfield Company (ARCO) in May 2011 to implement the Removal Action specified in the Work Plan.

2.1.4 Progress Metrics

Waste Stream	*Medium*	*Quantity*	*Manifest #*	*Treatment*	*Disposal*
Pond 18 - 2011	Lime precipitates	7500 cy	NA	NA	Pond 16/17 drying cells (IDF)
Pond 18 - 2014	Lime precipitates and calcines	8100 cy	NA	NA	Pond 13 and IDF
Pond 15 - 2012	Lime precipitates	3500 cy	NA	NA	Pond 13
Pond 11 and 12 - 2013	Lime precipitates	5700 cy	NA	NA	Pond 13
Pond 14 - 2014	Lime precipitates and calcines	1400 cy	NA	NA	Pond 13
Pond 14 - 2015	Lime precipitates and calcines	1700 cy	NA	NA	Pond 13
Demonstration Wetland Area	Lime precipitates and calcines	8000 cy	NA	NA	IDF and north staging area

2.2 Planning Section

No information available at this time.

2.3 Logistics Section

No information available at this time.

2.4 Finance Section

No information available at this time.

2.5 Other Command Staff

No information available at this time.

3. Participating Entities

DRMS has been funded by EPA and ARCO to provide support for underground investigations and adit rehabilitation oversight.

4. Personnel On Site

- AECOM was the lead technical contractor for ARCO 2011-2014
- AMEC Environment & Infrastructure, Inc. 2012-2014
- American Environment and Engineering Consultants, LLC
- Anderson Engineering Consultants Inc. 2011-2013
- ARCO/British Petroleum (2)
- DRMS
- EPA OSC
- START-URS Operating Services 2011-2014
- IRIS Mitigation and Design 2014
- Resource & Environmental Management Consultants 2014-2015
- USA Environment, L.P.2014-2015

5. Definition of Terms

No information available at this time.

6. Additional sources of information

6.1 Internet location of additional information/report

www.epaosc.org

6.2 Reporting Schedule

7. Situational Reference Materials

No information available at this time.